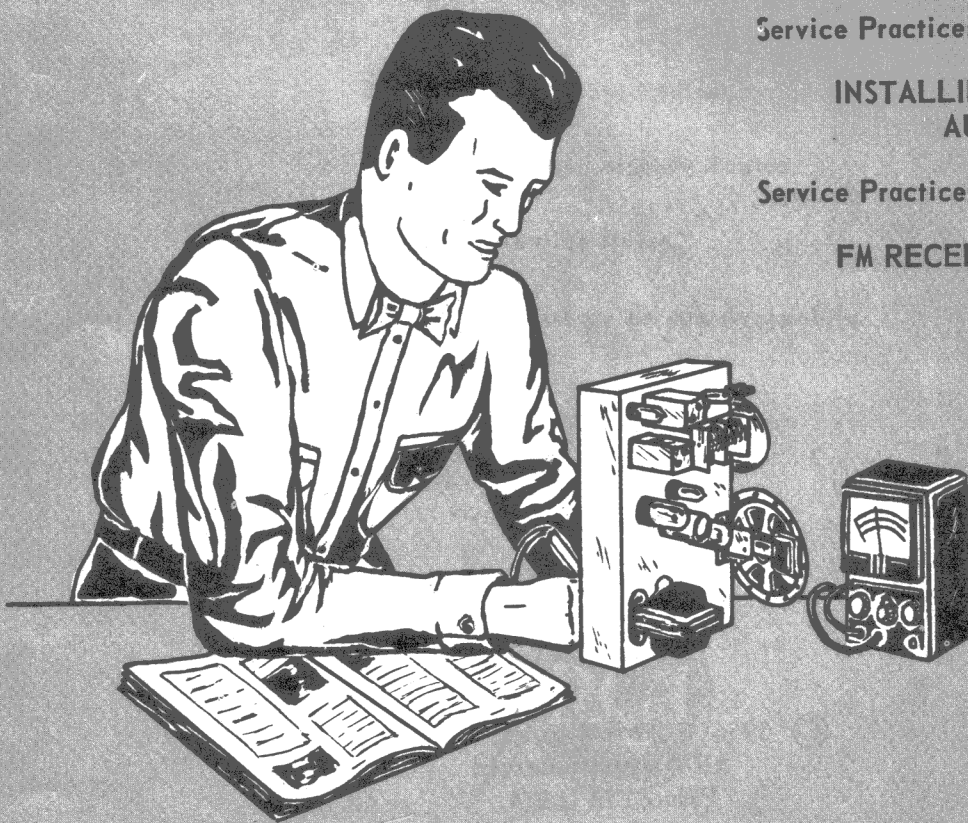


Study Group 19

ELECTRONIC FUNDAMENTALS



Service Practices 37:

INSTALLING AND SERVICING
AUTO RADIOS

Service Practices 38:

FM RECEIVERS



RCA INSTITUTES, INC.

A SERVICE OF RADIO CORPORATION OF AMERICA

New York.

N. Y.

ELECTRONIC FUNDAMENTALS

SERVICE PRACTICES 37

INSTALLING AND SERVICING AUTO RADIOS

37-1. Types of Auto Radios

37-2. Installation of Auto Radios

37-3. Eliminating Noise

**37-4. Where to Service the Automobile
Radio**



RCA INSTITUTES, INC.

A SERVICE OF RADIO CORPORATION OF AMERICA

HOME STUDY SCHOOL

350 West 4th Street, New York 14, N. Y.

Service Practices 37

INTRODUCTION

Since nowadays most automobiles have radios, there is a large market for installation and service work for the man who is properly prepared to do the job. A serviceman who knows how to service home-type sets knows almost all that is necessary to know about the *circuitry* of auto radios; the major circuit difference in an auto radio is in the power supply. What a serviceman needs to add to his knowledge of radio circuitry is information about how to identify different types of auto radios, how to install them, how to minimize or eliminate noise that may interfere with satisfactory operation, when a set must be removed from an automobile for further repairs, and how to make repairs on a set that is not removed from the automobile.

This Service Practices booklet is intended to give you the practical guidance you need in order to apply the knowledge of radio repair you have already developed to the profitable automobile-radio field.

37-1. TYPES OF AUTO RADIOS

There are two major types of auto radios—the *custom-built* set designed to fit into only one model of one make of car (or sometimes the same make of car for three or four years in a row) and the *universal* set, which

can be installed in any make of car. Two auto radios are illustrated in Fig. 37-1.

A custom-built set is identified as such by the distributor and comes with a complete set of installation instructions. The automobile into which the custom-built set is to be installed is already prepared for the installation. All mounting holes have been drilled and all mounting brackets placed. The only hole that needs to be drilled is the one for the installation of the antenna. Since the conditions for the installation have been so carefully prepared for when the car was made, you can't go wrong if you follow the instructions for the installation of a custom-made set. If you disregard the instructions, not only will you waste time but you may even do something wrong.

On the other hand, the universal-type set makes demands upon your ingenuity. You have to develop your own procedure for installation. And the first step in that procedure involves identifying the type of universal set you have and determining whether it is suited to the automobile in which you are going to install it. The two major types of universal sets are those that can be operated from a 6-volt battery and those that can be operated from a 12-volt battery.

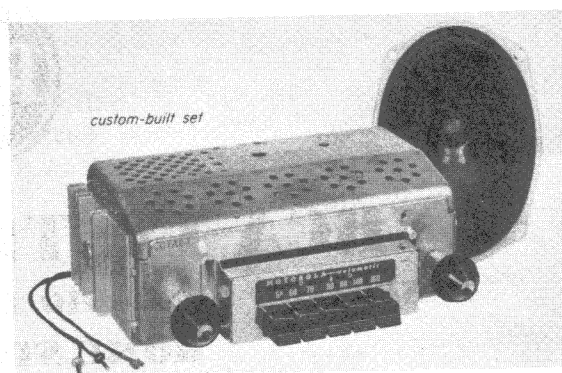
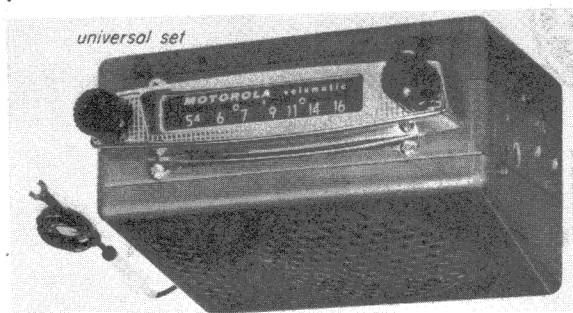


Fig. 37-1

Automobiles are also divided into those that have 6-volt batteries (most cars built up to 1954 used 6-volt batteries) and those that have 12-volt batteries (which came into more common use in 1954). In order to make sure which type of battery a car has, you must check the battery itself. Once you know what voltage a car requires, you know whether they match or not. If they match, the set can be installed in the auto.

There are differences between universal radios that do not determine whether or not a set can be installed in a particular auto. Some sets use vacuum tubes and conventional vibrator power supplies; other sets use transistors and therefore do not require any power transformer to step up the voltage of the battery, nor do they need vibrators to provide a.c. for the transformers; other sets use a combination of transistors and vacuum tubes; still other sets use a special type of vacuum tube that uses a 12-volt battery supply for the high voltage supply. You will come across these differences when you examine the circuits of various sets during your career. But right now, let's concentrate on practical details of installation.

At this point, you have identified the type of set you have and are prepared to begin the installation. If you wish, before proceeding, you can make an operation check of the set to see if it is in operating order before you install it.

37-2. INSTALLATION OF AUTO RADIOS

Installing the Antenna. No matter what type of auto radio you are installing, the first step in the installation procedure is installing the antenna. Auto antennas are all basically alike. A typical antenna is a metal rod that telescopes and is mounted in a base. Antennas may be anywhere from 36 to 90 inches long. The lead-in from the antenna is a coaxial cable. This cable goes from a coaxial socket in the antenna base all the way to the radio receiver, which, whether it is custom made or universal, is usually mounted near the dashboard of the automobile. On its way from the antenna base to the radio receiver, the lead-in trav-

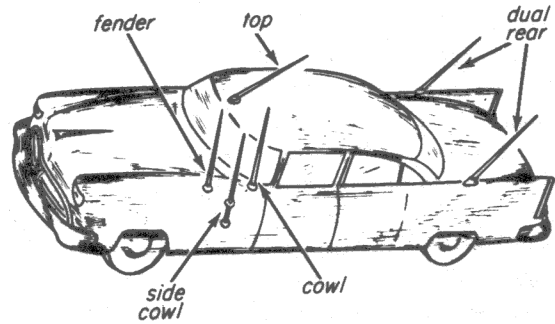


Fig. 37-2

els a distance inside the metal body of the auto. If the lead-in were not coaxial, it would pick up all the noise generated inside the body of the car (for example, noise caused by ignition). However, since a coaxial lead is used, the lead-in is shielded. Actually, the inner conductor of the coaxial cable is the lead-in. The outer conductor, which is grounded on both ends, is the shield. The shield is grounded at one end at the antenna base. The other end of the shield is grounded to the chassis. Thus any noise picked up by the shield is run off to ground.

The major differences between antennas are mechanical adaptations that permit them to be mounted at different points on the body of the automobile (Fig. 37-2).

One type, the cowl-fender antenna (Fig. 37-3), is so called because it can be mounted on the cowl of the automobile between the windshield and the hood or, if there is no room there, on top of a front fender. A similar type of antenna, which came out in 1955, is called the *rear-mount type* because it is installed on a rear fender (Fig. 32-4a).



Fig. 37-3

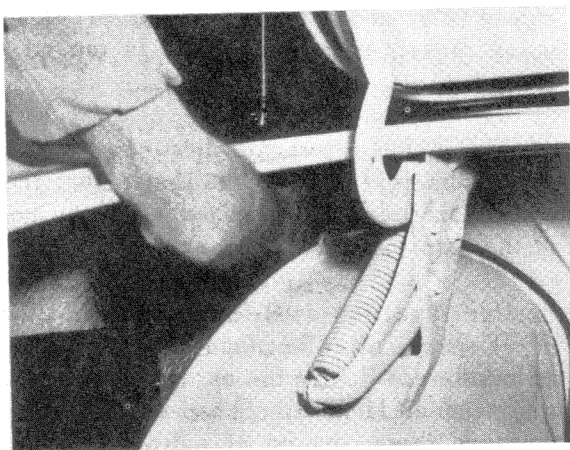
Because the coaxial lead-in from a rear-mount antenna must travel so far to reach the receiver, it is necessary to reduce the capacitance between the two conductors of the lead-in by placing a small capacitor in series with the lead-in itself (Fig. 37-4b). Often rear mount antennas are used in pairs, one antenna being mounted on each rear fender. The two antennas are connected to each other by a coaxial cable of the same type that is used for the lead-in (Fig. 37-4b). The lead-in runs from the center of the coaxial cable that connects the two antennas together to the radio receiver. Usually the connection between the antennas and the lead-in form part of a single harness. Often this harness is T-shaped and is called a T-harness. Two antennas mounted on the rear of an automobile are shown in Fig. 37-4c.

The top-mount antenna (Fig. 37-5), mounted in the center of the top of the auto-

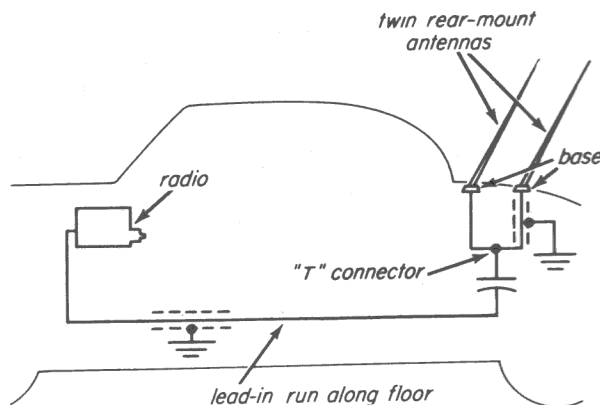
mobile, just above the windshield, uses a lead-in cable that runs down one of the windshield posts.

The most common types of antenna installation used are the cowl-fender type and the rear-mount type. Let's discuss the installation procedure for the cowl-fender type. Once you have learned this procedure, you can use it for rear-mount type antennas too, except for the running of the lead-in.

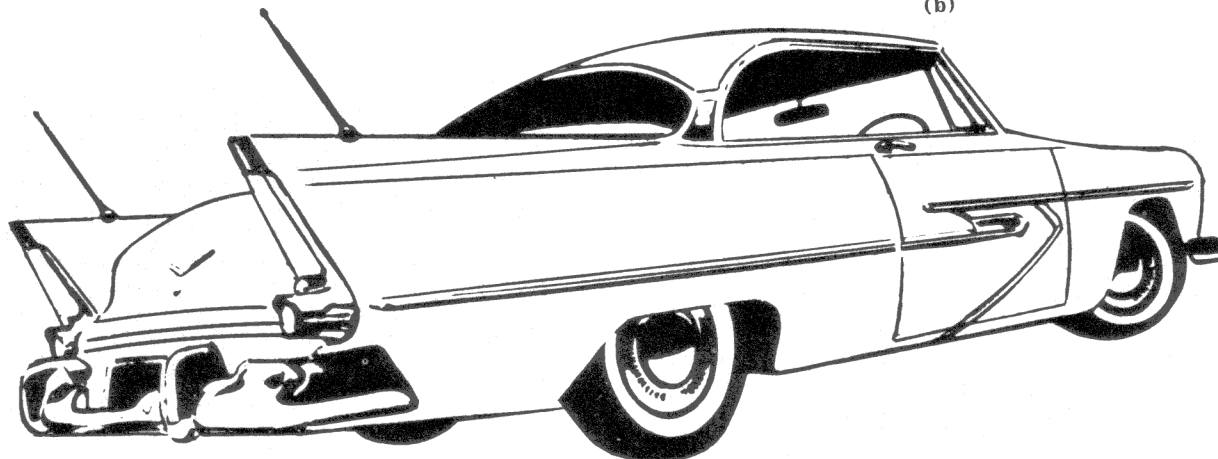
The first step is to select the proper place for mounting the base for the antenna. This base is mounted on the sheet-metal sheath that covers the framework of the car. Under this sheet-metal sheath are metal braces or other obstructions. Before you select a point on the body of the car for mounting an antenna base, look or feel inside the sheath to be sure that there is an unobstructed area large enough for mounting the antenna.



(a)



(b)



(c)

Fig. 37-4

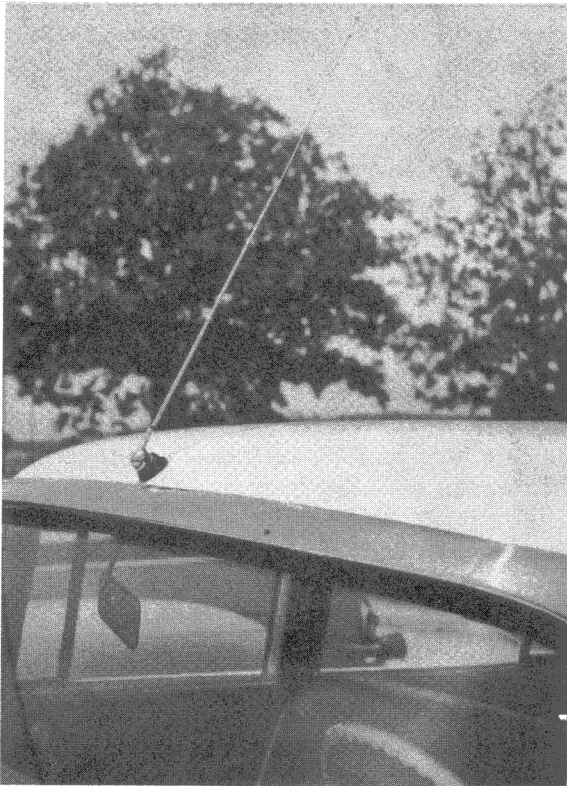


Fig. 37-5

Caution: Never bore or punch a hole at any point on an automobile without being sure that there is no obstruction inside. Otherwise you may damage or mar the appearance of the auto.

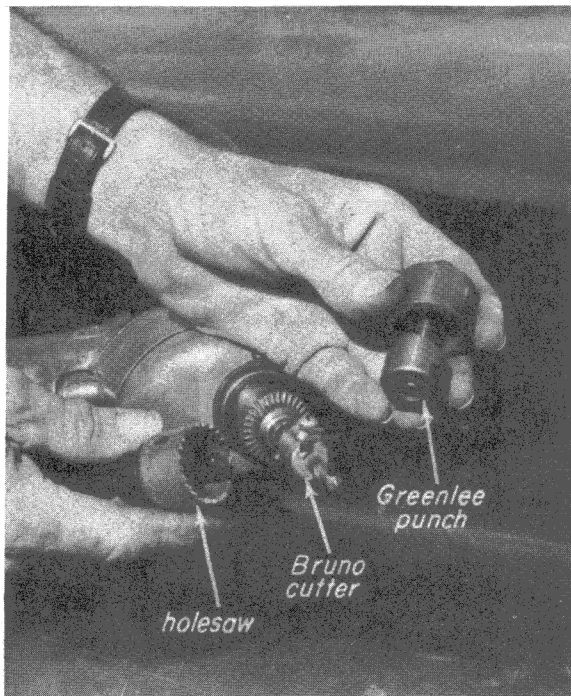


Fig. 37-6

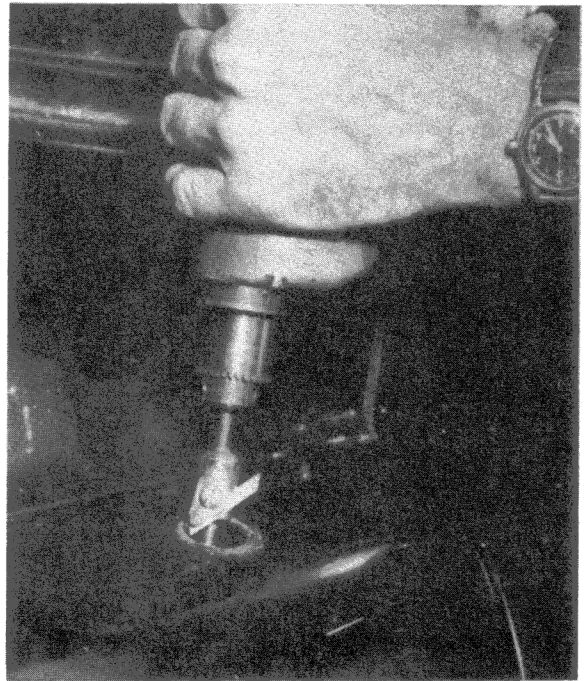


Fig. 37-7

If you are installing an antenna for a custom-built radio, you will not have to make this check. The template provided with the set will guide you to the exact spot where the hole for the antenna base should be drilled. The hole for the antenna base is, on the average, from $7/8$ inch to 1 inch in diameter. If you do not have a special cutting tool for drilling such holes, you can use an electric drill with a $1/2$ -inch chuck and a large assortment of bits.

However, special cutting tools (Fig. 37-6) make the job easier. Among these special cutting tools, are the *Bruno* cutters, which can be used in a $1/4$ -inch electric drill (the size found in most service shops); the *Greenlee* punches, which are of the *die and anvil* type, and the hole-saws, which might be described as round hacksaws. A Bruno cutter is used in locations where there is not enough room for a Greenlee punch or where an odd-sized hole is required. Figure 37-7 shows a Bruno cutter in use. Any of these cutting tools will help you drill a smooth round hole.

Before you can use the Greenlee punch, you must start the hole. For this purpose, a punch at least 8 inches long, sharpened to a point like a centerpunch, should be used. Drive the sharp punch through the sheet metal, and continue driving it in until the hole is

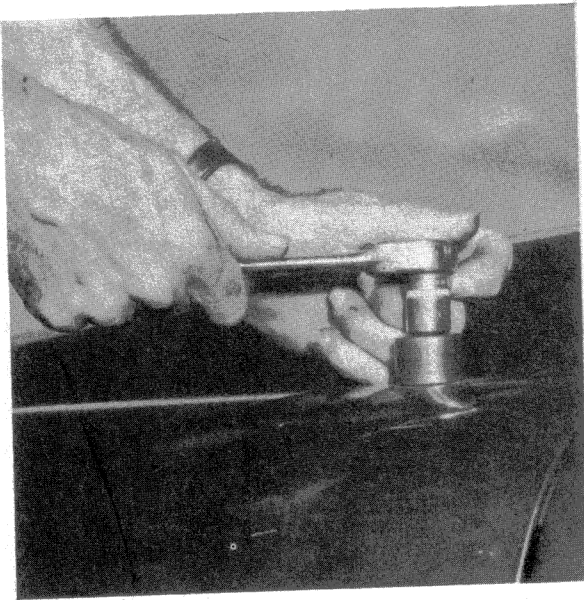


Fig. 37-8

large enough to admit the bolt of the Greenlee punch. Assemble the Greenlee punch with the cutter on the inside and the female, or anvil, half of the punch on the outside of the body (Fig. 37-8). In the figure, the $\frac{1}{2}$ -inch square-head bolt is covered by a wrench. When you turn this bolt with a common end-wrench, an adjustable wrench, or a socket wrench with a ratchet handle, you bring the halves of the Greenlee punch together. Simply keep turning the bolt until you hear the cutter snap through the last bit of metal and the punch comes free. Take the punch out and you will have a neat round hole.

After you have drilled the hole for mounting the antenna, the next step is to assemble the antenna. In the typical installation we are discussing, the antenna base has two halves. Fasten the coaxial lead into place on the lower half of the base. Then run the coaxial lead down into the hole until the lower half of the antenna base is seated on the cowl or fender and worked into place. Then place the antenna rod into the lower half of the antenna base and drop the remainder of the parts of the base into place in the proper order (Fig. 37-9). In the figure, the bottom half of the base is in position and the upper half of the base is being slid into place. The correct order of assembly is: rubber washer, top or plastic half of insulator, eccentric washer, and nut. Up to this point, the parts have been loosely assembled by hand. Tighten the nut finger tight and check

the position of the antenna. It should be vertical. If it is, tighten the antenna with a wrench.

The next step is to run the lead in to the radio where it can be connected. If you are mounting the antenna on the cowl, this presents no difficulty. All that remains to be done is to fit the lead-in inside the body of the car, under the dashboard, and connect it to the radio before the radio is installed.

However, if you mount this type of antenna on a fender, it may be necessary to punch a hole through the upper inside part of the fender into the body of the automobile (Fig. 37-10). (It is possible that this hole has been already punched by the manufacturer of the automobile. If so, the hole will have a rubber grommet or washer in it.)

If there is no hole, use a long punch to make one in a place that will permit the shortest run from antenna to receiver and also not allow the lead-in to be caught and cut by the hood-hinges, etc. Drive the punch through until the hole is large enough to permit passage of the lead-in cable. The reason that this hole is punched rather than drilled is that the punch leaves a hole with



Fig. 37-9

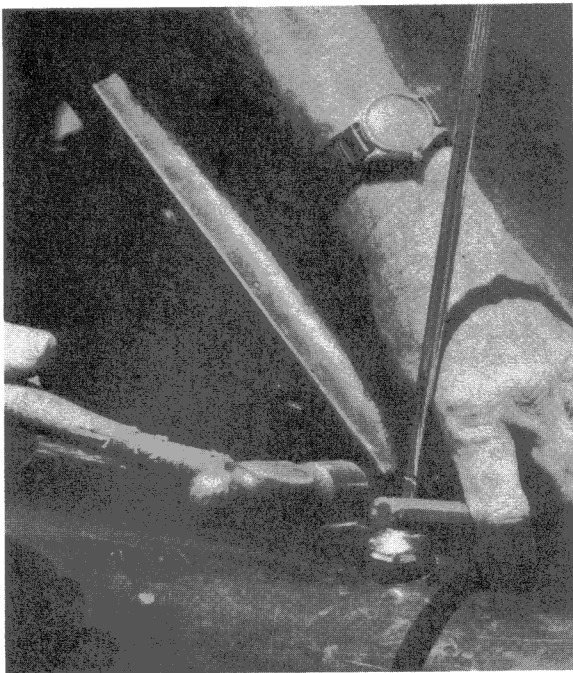


Fig. 37-10

the edges rounded. A drill makes a sharp-edged hole that may cut the lead-in cable.

The procedure for mounting a rear antenna is similar to the procedure for mounting the front types. The antenna is mounted on top of the rear fender. If you're using a dual antenna, the two antennas are mounted on two rear fenders. The connecting cable and matching harness for the dual antennas will be included in the package along with complete instructions for interconnecting the two antennas and installing the harness.

Let's discuss the mounting of a single rear antenna. After you have selected the point at which you are going to mount the rear antenna, bore a hole in the fender, attach the lead-in to the lower half of the base, run the lead-in through the hole, and assemble the rest of the antenna to the base just as has been described for an antenna mounted on the front fender. Figure 37-4a shows the lead-in brought through the rear fender.

The lead-in will now be inside the trunk. Run it down the sidewall and along the floor of the trunk. The lead-in should be fastened in place. If the trunk space is covered with a mat, raise this and tuck the lead-in under it. Run the cable up to the back of the rear

seat, which is usually separated from the trunk proper by a fiber wall. There is always a sufficient space underneath this wall to allow the lead-in to be pushed through into the car body itself.

Remove the rear seat. Run the lead-in along the outside edge of the floor, being careful to place it so that it will not be crushed or cut by the frame of the seat when it is replaced. Next, lift the edge of the floor mats all the way along the side of the car. There will generally be a trough in the floor itself. Place the lead-in cable in this trough and replace the mats. In many cars, the front-seat floor-mats are made of rubber, backed with a heavy jute padding. If necessary, cut or tear off a small strip of this padding to allow the lead-in to lie flat on the floor without making a hump in the mat. Be sure that the cable has enough cover at all places to avoid its being crushed or otherwise damaged by normal passenger movement. When you reach the front seat, bring the lead-in out at the upper edge of the mat and over to the set, just as in the other types of installations.

If the installation uses dual antennas, except for connecting the cable and harness between the two, the installation procedure is just the same as for the single antenna. Run the connecting cable up and over the top of the rear deck on the underside of the trunk. Be sure that the cable is well fastened in place, so that it will not interfere with the use of the trunk. Tape or tie it to the metal framework, until it reaches the corner of the trunk. Run down the corner and under the rear-seat back cushion, as outlined before, and as shown in Fig. 37-4b.

A top-mounted antenna is placed above the windshield halfway between the right and left sides of the automobile. Usually a top-mounted antenna can swivel on its base and has a knob that fits inside the auto so that the antenna can be swiveled by someone sitting in the front seat.

Top-mounted antennas are difficult to install. The installation procedure for one such antenna might be quite different from the installation procedure for another one. However, these antennas come with installa-

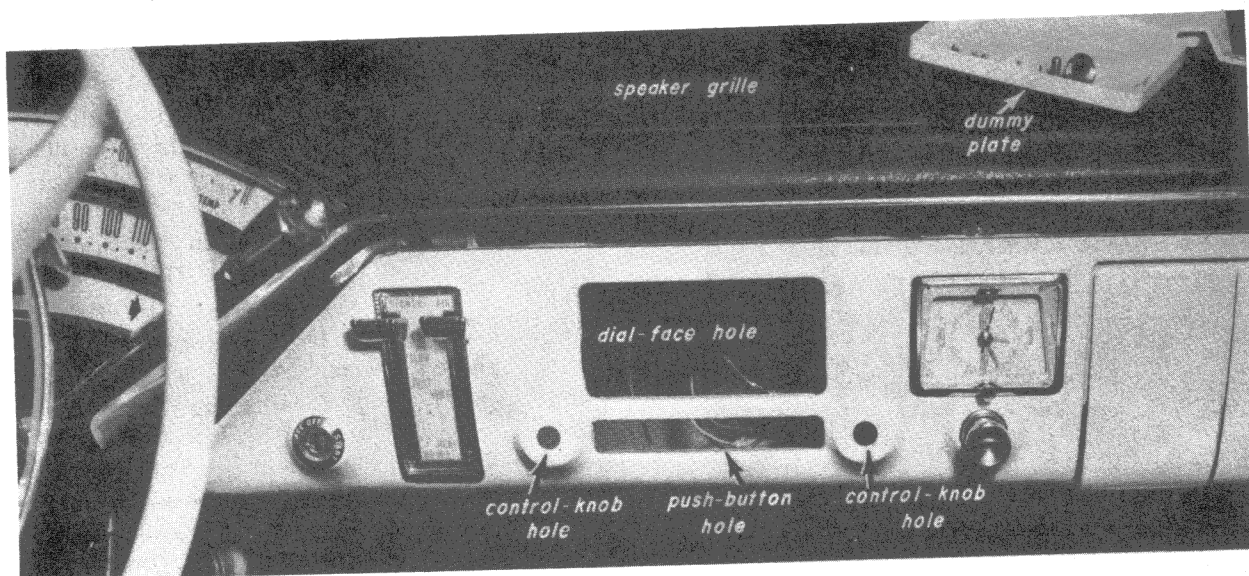


Fig. 37-11

tion instructions. Follow these instructions carefully. As a matter of fact, these instructions are so important that it is wise to insist on having them before you accept an installation job involving a top-mounted antenna.

Note: No matter what kind of antenna you are installing, it is important that you do not damage or soil the customer's automobile while you are working. Do not handle upholstery, if your hands are dirty or oily. Be sure to use a drop cloth if you place your tools in the customer's automobile. Remember to be careful when punching mounting holes. A crudely punched hole may spoil the appearance of a new automobile.

Installing the Custom-Built Set. After the antenna has been mounted, the next step is the installation of the set. Let's begin by considering what is involved in the installation of a custom-built set.

Since the set has been made for a particular automobile, complete instructions for the installation come with this set. The first thing to do is to read these instructions carefully and examine the car and the set itself.

Different sets require different types of mounting brackets. One of the major differences between sets is that some are complete in one unit and others are made in two units. The mounting equipment is adapted to the number of units you have to mount.

If the set has two units, one unit may contain the power supply and audio sections.

The other unit contains the tuning, r-f, and i-f units. The controls are mounted on the r-f/i-f unit.

Once you have read the instructions and identified the type of set you have, you can begin the installation. The first step is to remove the dummy panel that covers a hole or several holes through which the radio controls and the radio dial are to go (Fig. 37-11). If there is a grille built into the dashboard, as shown in the figure, remove the cardboard backing that is behind it.

If your set is made up of two units, you may have to install the power-audio unit first. This unit is not always in a cabinet. It is usually mounted on a heavy metal plate or bracket that fits onto bolts behind the dashboard. When the metal plate is properly in place, the speaker will be properly positioned behind the grille in the dashboard. The speaker may have a rubber gasket that fits between the speaker rim and the dashboard to seal up the sides and improve the tone. Once the speaker and gasket are in place, fasten the power unit with nuts. A typical installation of a power unit is shown in Fig. 37-12. This is a right side view. The parts are mounted on a metal chassis, which is fastened in place by mounting lugs, protruding beyond the edges of the chassis. The speaker is faced out at the bottom of the chassis so that the sound comes through the dash grille.

The bolt at top is provided in the car. The bottom edge is fastened to the lower

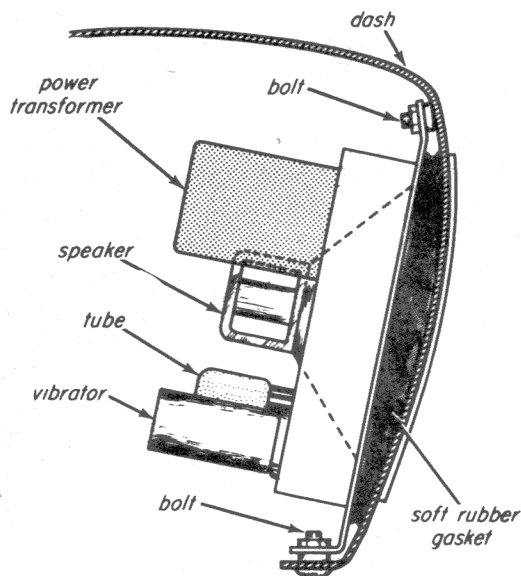


Fig. 37-12

flange of the dash, through holes already drilled.

After the power unit is in place, the tuning unit can be installed. The tuning unit has control shafts that will fit through holes in the instrument panel. The dial will fit through a space provided in the instrument panel. These holes and spaces were exposed when you removed the dummy panel.

The control shafts are made so that they can support the front of the tuning unit. Each shaft is in a hollow metal sheath.

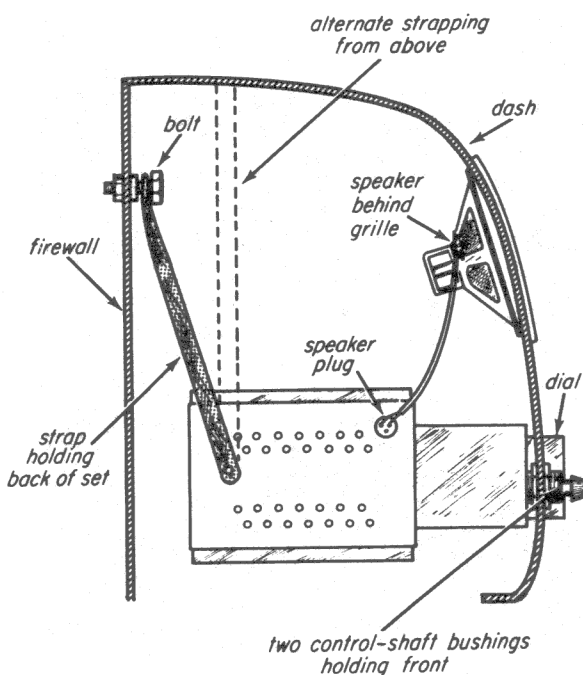


Fig. 37-13

This sheath is threaded at the end. The threaded portion of the sheath extends far enough through the hole in the dashboard so that the set can be fastened in place with a nut. The back of the tuning unit is supported by straps or brackets.

The separate units are connected by cables and plugs. Sometimes it is possible to put the plugs in incorrectly. Watch out for plugs that can be connected in more than one way. An improper connection may blow a fuse or damage the set.

The procedure for installing a single unit set is quite similar to the procedure for installing the tuning unit of a two-unit set, as described above. A typical installation is shown in Fig. 37-13. The control shaft bushings go through the front of the dash, and are held by large thin nuts; the back is held by a heavy sheet metal strap, bolted to the firewall. This gives the necessary three-point suspension.

Some sets use two straps for the back, fastening them above the set, so that the pull is straight downward for better results. No matter what kind of strap you use, always install it so that the weight of the set *pulls* on it; never use sheet metal straps for holding a pushing strain.

Installing Separate Speaker. In addition to single-unit sets and two-unit sets that consist of a power-audio unit and an r-f/i-f unit, there is a third type of set in which all the parts except the loudspeaker are in one unit. The set mounts in holes provided in the dashboard, and the speaker is mounted behind a grille in the dashboard. The speaker must always be installed first, before the set, because the set covers the speaker. The speaker is connected to the set by a cable (usually only two wires) and a plug that fits into a socket provided on the set. You may have to plug in the cable before the set is put in position. A schematic of the speaker connections is given in Fig. 37-14; in *a* a single speaker is connected, and in *b* two speakers are connected to a switch so that either or both speakers can be used.

Car-radio speakers are now all of the PM (permanent magnet) type. The only connections needed are those of the voice coil. It is common practice to ground one side of

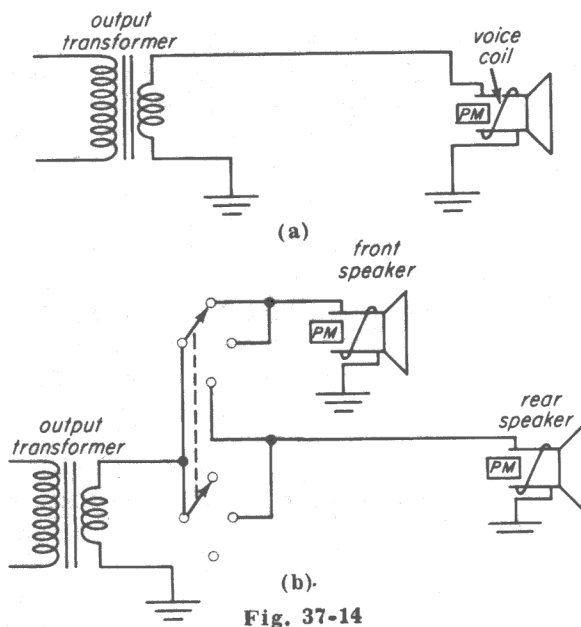


Fig. 37-14

the voice coil to the speaker frame, which, like the receiver is grounded to the frame of the car itself. Thus only one wire — the hot wire to the secondary of the output transformer — is needed. In fact, the extension speakers can be connected, if necessary, by running only one wire back to the set and grounding the other wire at the speaker.

Installing The Universal Sets. A common type of universal set is the underdash set, so called because it is built to be installed under the edge of the dashboard (Fig. 37-15). Two brackets support the set in front, and a back strap holds the weight of the back end. Conversion kits make it possible to mount some underdash sets in place of the custom-built radios (Fig. 37-16), particularly if the custom set is usually mounted in or near the center or lower edge of the dash and has a separate speaker. Many underdash sets have separate speakers. The sets themselves are small and compact. Notice in the figure that a special mounting plate in the front of the escutcheon fills up the hole and gives the installation the appearance of a custom set. The radio itself, although not visible, is the same as the small set seen in Fig. 37-15.

Using a bit of ingenuity, you'll discover many ways in which these small sets can be mounted. Some servicemen cut holes in the blank dashboards of pickup trucks and install universal sets. If the right hole-cutters are used, as mentioned before, this can be done without too much trouble. Be sure that you

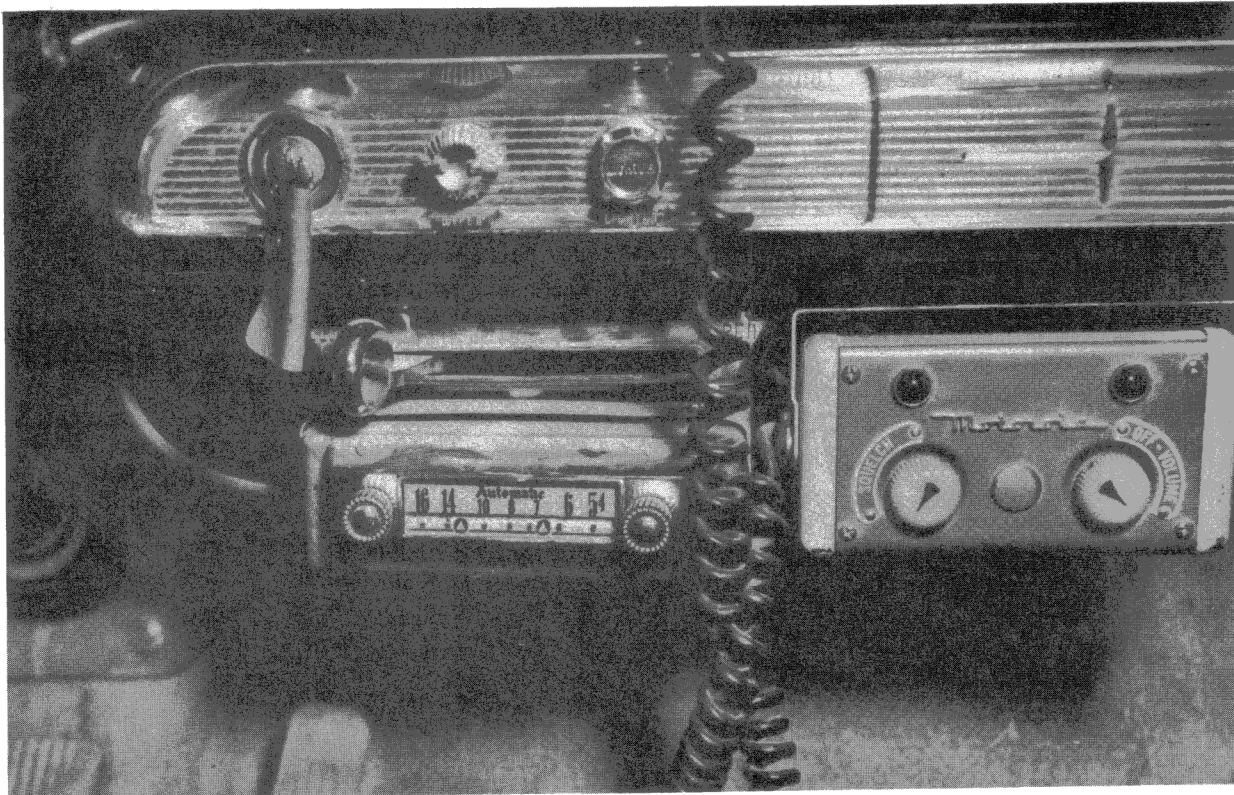


Fig. 37-15

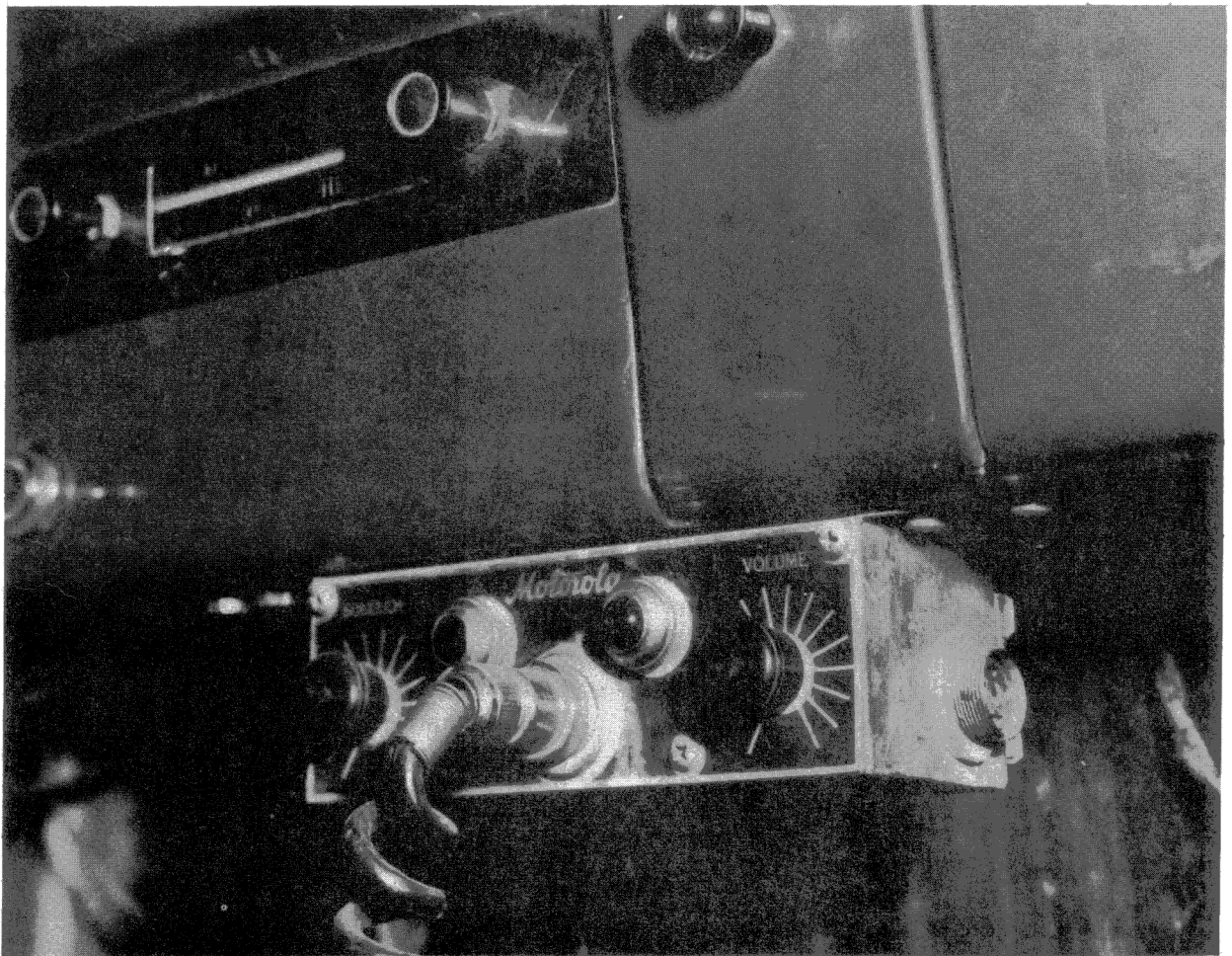


Fig. 37-16

that you can make a neat installation before you cut any holes.

Installing Custom-Made Sets in Other Cars. Many custom sets are impossible to mount in any car other than the brand for which they were designed. They cannot be installed in such a way that the controls are accessible to the driver and so that they look well. If you are asked to install a custom-made set in a car into which the set cannot be made to fit properly, explain to the customer the difficulty of making a decent-looking installation. If he still wants the set installed, go ahead, but be sure that he understands why it will look like it does.

However, some custom-made sets can be installed in cars other than those for which they have been made (Fig. 37-17). If the cabinet of the radio is not too large, and fairly flat, similar in shape to the regular universal type, and it has a separate speaker,

it can be mounted under the dashboard. A home-made sheet-metal strap can be used to hold the front end or small brackets can be used to support the sides.

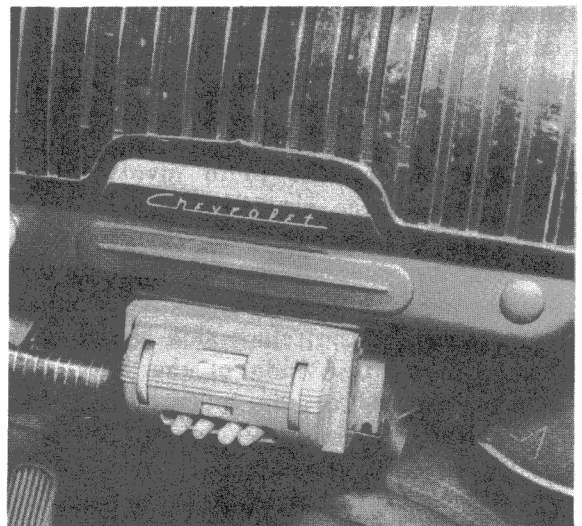


Fig. 37-17

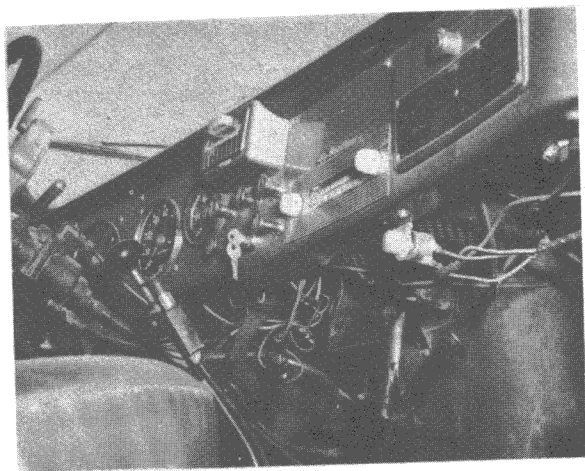


Fig. 37-18

Truck Installations. Installations in trucks allow the installer a great deal more latitude than do passenger cars; the drivers are usually more interested in getting the sets to play than in how they look.

In Fig. 37-18, a universal set is mounted in the dash, while the speaker is mounted in a special baffle on the roof of the cab. In trucks, almost any type of mounting can be used, the only requirement for such a mounting is that it be sturdy enough to withstand the pounding and jolting that it will get. The set should be mounted with heavy straps and braces, well bolted together and securely fastened to the set itself. When laying out your braces and straps, be sure that they do not cover up any of the controls or connections, such as the antenna socket, hot-wire leads, speaker plugs, etc. If the straps must cover one of these, bore a hole in the strap to provide access to the part covered.

Electrical Installation. Part of the installation of an auto radio involves connecting it into the electrical circuit of the auto. The source of power is the car's battery, which has an output of either 6 or 12 volts d.c. The metal frame and body of the car serve as the return side of the electrical system. One side of the battery is always grounded to the frame. Sometimes, the positive terminal is grounded, sometimes the negative. For instance, Ford automobiles have positive grounds, whereas General Motors automobiles have negative grounds. Information about polarity is important when you are working with sets that use the bat-

tery of the automobile as the only voltage source. If you are in doubt about the polarity, check it with a voltmeter. The installation instructions for such sets always mention polarity. Usually a means of changing that set's polarity is provided—for example, a terminal board with two leads that can be interchanged or reversed.

Polarity is not an important matter when you are working with a radio that has a vibrator-transformer power supply. All that you have to do when you install sets of this type is to hook up the hot wire. Grounding is automatically taken care of when you bolt the metal frame of the receiver to the metal frame of the automobile.

A lead with a fuse in it is used to connect a car-radio to the battery supply. The fuse holder holds the protective fuse and also serves as a quick disconnect when the set must be removed from the car for service. In the custom installations, this lead will go to a specified place; for instance, to a terminal board for the electrical system that holds separate fuses for all of the equipment, including the radio. As a general rule, the hot lead of the radio should be connected to the load side of the ignition switch if the ignition switch is of the three-way type that may be turned to the left to turn on accessories, such as heater, radio, etc. without turning on the automobile ignition, turned to the right to turn on all the accessories and the automobile ignition, and turned to a center position to turn off all power. When the hot lead of the radio is connected to the ignition switch, the radio can be played only when the ignition key is in the lock. This prevents unauthorized use of the set and also keeps the owner from absent-mindedly leaving it on when leaving the car.

If the ignition switch is not like the switch we have just discussed, connect the hot lead of the radio to the load side of either the ammeter or the light switch; do not connect it to the same terminal as the car's ignition.

37-3. ELIMINATING NOISE

In order to follow the discussion of eliminating noise, refer to the schematic

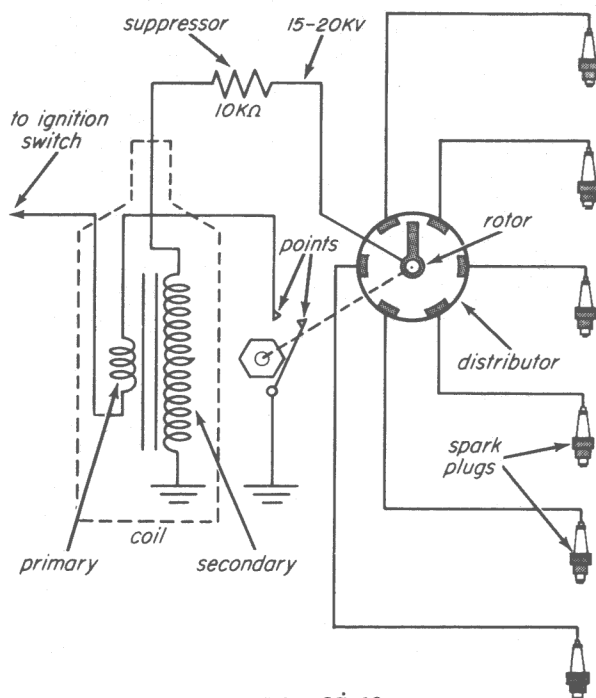


Fig. 37-19

of the ignition system of an automobile shown in Fig. 37-19. This ignition system, used in a six-cylinder automobile, is not difficult to understand. When the ignition switch is turned on, it is possible for battery current to flow in the circuit. Battery current does flow if the circuit is complete. The circuit is complete if the breaker points make contact. In the illustration, the points are not making contact. The points are being held apart by an edge of the hexagonal cam.

The cam rotates regularly as the pistons of the automobile go up and down. That means that first an edge of the cam is opposite the points and then a flat side of the cam is opposite the points. When a flat side is opposite the points, the points are not held apart; therefore the points complete the circuit. Thus, the primary circuit is opened and closed as the pistons of the automobile go up and down.

Each time the primary circuit closes, there is a surge of current in the primary of the transformer. This surge of current induces a voltage in the secondary. The turns ratio is high, so a high voltage is induced in the secondary. This voltage goes to the spark plugs by way of the suppressor resistor and a rotary switch, which is called

the distributor. The distributor is mechanically linked with the hexagonal cam, and rotates at the same rate. Each time the rotor of the distributor contacts one of the stationary contacts, a voltage is applied to one of the six spark plugs. The spark plug produces the spark required for internal combustion in one of the cylinders.

When checking for noise in a car, always be sure that the hood is down and firmly latched; this is necessary to keep the engine noise inside the engine compartment. The metal hood, front fenders, etc. form a shield, keeping the noise in. If you make checks with the hood raised, this noise will escape and be picked up by the antenna rod itself.

Plug Noise. Perhaps the most common and annoying type of noise is *plug noise*, a popping sound heard every time a spark-plug fires and rising in pitch (frequency) as the engine is speeded up to a loud roar. The noise actually originates at the breaker points of the distributor when the breaker points draw an arc upon breaking. This type of noise can be eliminated by inserting a large resistor in series with the high-voltage lead. This *suppressor*, (Fig. 37-19) helps to eliminate this noise by reducing unnecessary sparks. Although many mechanics insist that suppressors are harmful, repeated tests by the U.S. Army and many other agencies have shown that suppressors, even when used on the distributor and all spark plugs, have no ill effects upon a properly adjusted engine. If the distributor suppressor does not entirely eliminate the noise, try using separate suppressors on each spark plug. The old spark plugs can be replaced with *resistor plugs*, spark plugs that have built-in suppressors.

Distributor suppressors are made in two types. The most common type is known as a *cable-type* suppressor and has a black plastic shell; there is a brass screw inside each end of the shell. In order to install a cable-type suppressor, cut the distributor wire between the center of the cap and the center terminal of the coil (a good place to cut is about two inches above the cap), and screw the cut ends of the wire into the ends of the suppressor (Fig. 37-20). It isn't necessary to strip the insulation from the distribu-

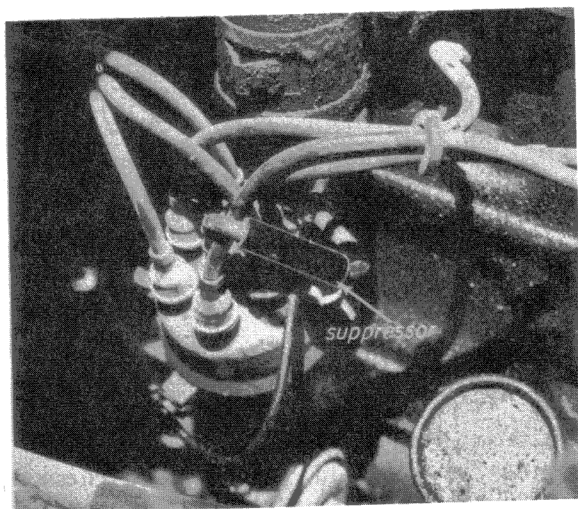


Fig. 37-20

tor wire. The screws on the suppressor bore in all the way through the insulation and make contact with the wire itself. A bypass capacitor may also be installed on the ignition coil, visible above distributor, to suppress remaining plug noise. The bracket for this condenser is on the side of the coil housing.

The other type of suppressor, the plug-in type, has a plug on one end and a socket on the other. In order to install a plug-in suppressor, simply pull the wire out of the distributor cap, plug the suppressor in, and plug the wire into the suppressor.

Spark plug suppressors are usually of the plug-in type. The wire is pulled off the plug, the suppressor is slipped on, and the wire is plugged into the suppressor. The wire should make a firm connection with the suppressor so that it will not be jarred loose when the car is moving.

Generator Noise. *Generator noise* is a howling noise that varies in pitch with the speed of the engine. It is *not* heard when the engine is idling or running so slowly that the generator is not charging. It is caused by the small arcs made by the brushes running over the surface of the commutator. This type of noise is an a-c current superimposed upon the pure 6 or 12 volts d.c. that we want. In order to get rid of these noise pulses, we simply install a bypass capacitor at their point of origin—in this case, right on the generator itself.

A special type of bypass capacitor of 0.5 μ f, 200 volts is used for this purpose.

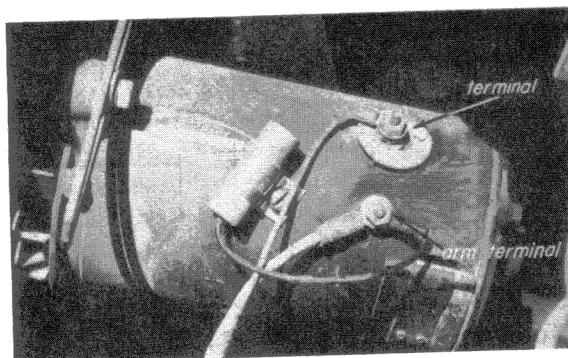


Fig. 37-21

Sometimes you will hear such capacitors called "generator condensers". The body of the capacitor is in a metal case with a metal tab, called an ear, that serves as one lead (ground) of the capacitor. The other lead of the capacitor is a pigtail of heavy-braided wire terminated in a spade lug. In order to connect this capacitor, connect the spade lug to the terminal bolt on the generator to which the larger of the two wires from the generator case is connected. This is a connection to the armature of the generator marked ARM. Do not connect the capacitor to the smaller lead from the generator case. This lead is the field lead and is marked FLD. Connecting the spade lug from the capacitor to the field lead of the generator will actually increase the noise. Usually the field lead has a paper collar on it warning you not to connect a bypass capacitor to it. The ear on the body of the capacitor, which serves as the other lead of the capacitor, should be grounded against the body of the generator. Usually there is a bolt on the body of the generator that can be used for this purpose. Loosen the bolt, slip the ear of the capacitor under the bolt head, and tighten the bolt. Figure 37-21 shows a generator capacitor completely installed.

Voltage-Regulator Noise. The voltage regulator is a set of three relays that control the charging rate of the generator. Noise originates in the contact points of the relays as they open and close. This noise is quite similar to plug-noise and can even be mistaken for it, unless you are alert to the small difference. Although regulator noise is a popping noise, it does not have the smoothness and regularity of real plug noise; it is more erratic, and varies in pitch. It is usually *not* heard when the engine is idling,

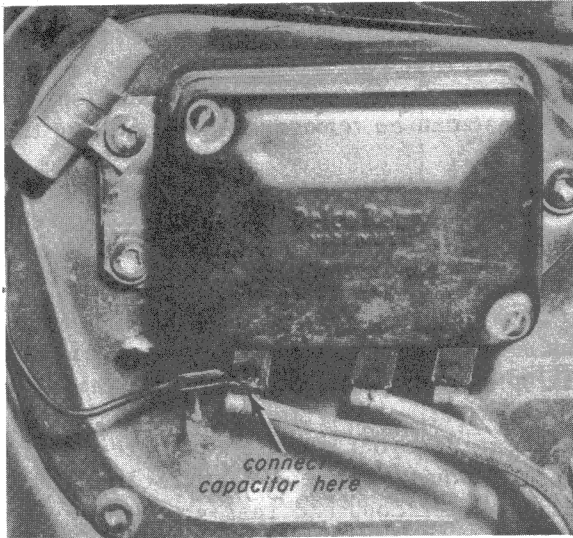


Fig. 37-22

especially if it is slow enough to keep the generator from charging. Plug noise, on the other hand, is usually worse when the engine is idling; the sparks are of longer duration. To eliminate regulator noise, install a bypass condenser on the voltage regulator. Fasten the ear of the capacitor under one of the bolts holding the regulator itself to the firewall (the metal partition between the engine compartment and the driver's compartment). Fasten the spade lug to the terminal marked BATT; never fasten it to either of the other two terminals (Fig. 37-22), which are marked FLD (field) and ARM (armature).

In some cases of severe plug noise, you will have to install a bypass capacitor on the battery side of the ignition coil. Do not connect this capacitor to the switch (breaker point) side, as this will upset the ignition system. Trace the wires; one runs from the coil down to the distributor itself; the other wire, to which the capacitor should be connected disappears into a bundle of wires leading toward the firewall. In Fig. 37-19, the wire to which the capacitor should be connected is shown leading from the coil primary back to the ignition switch. Sometimes the capacitor is connected to the wire right at the ignition switch on the dashboard

Wheel Noise. A loud ripping or scratching noise, heard only when the car is in motion, even with the engine off, is caused by the front wheels; the wheels become temporarily ungrounded, due to the insulating ef-

fect of the grease in the front hubs. The resulting noise is due to the accumulation of static charges caused by the friction of the tire on the road. These charges are intermittently discharged through the wheel, producing a popping noise in the radio. The remedy for this is to furnish a constant ground by installing special front-wheel grounding springs inside the grease caps. These are small special spiral springs with a sharp point on one end. The spring is inserted in the grease cap so that the point will sit in the *lathe-center* (the small depression in the end of the front spindle) when the cap is replaced. Thus, the springs provide a continuous ground while the wheel is turning.

Fuel-Gauge Noise. The fuel gauge used on many cars is a source of noise. This produces a popping noise, something like a combination of front-wheel-noise and plug noise. To check for fuel-gauge noise, turn the engine off but leave the ignition on so that the fuel gauge is working. Jar the automobile by stamping heavily on the rear bumper. If you hear a popping, it is fuel-gauge noise. To eliminate this noise, install a bypass condenser at the *tank unit* of the gauge. Connect the pigtail to the center terminal, grounding the case under one of the screws that hold the unit in the tank. Some automobiles have a special fuel-gauge filter—a small coil and capacitor mounted on a fiber card with brass eyelets for the terminals. This filter is installed on the back of the fuel-gauge indicator unit on the dashboard. Although it is possible to install a bypass capacitor at this unit, in most cases this will do no good at all; the bypass capacitor must be mounted on the tank unit.

Loose Ground on Lead-In. In older types of antennas, noise may be caused by loose ground connections on the shielding of the lead-in cable itself. This noise can result, even in late model antennas, from improper installation, a dirty or loose connection on the lead-in cable, or a break in the shield. In order to check for this noise, remove the plug from the set while the set is on and the engine is running. If this causes a large reduction in the noise, check the lead-in cable for grounding.

Leakage in Antenna. In antennas, noise pickup may be due to electrical leakage across the base insulator or leakage from the lead-in cable. Although this happens mostly in the cheaper antennas, it can happen to any antenna if an insulator is broken, allowing moisture to enter. Make a continuity check by checking from the pin tip of the lead-in to the antenna rod. You should read about from 3 to 5 ohms, the resistance of the very fine wire used as the actual conductor. Measure from the antenna rod itself to the body of the car. This reading should indicate an open—no reading at all on the highest range of your ohmmeter. The reading from the shell of the plug back to ground should be absolutely zero on the lowest range.

If, after making these tests, you still have some doubts about the antenna, plug another antenna into the set. Hold it by the insulators, pull the rod out to its full length, and hold the rod outside the car, grounding the base of the insulator on a nearby metal part of the car body. Now, try the radio. If there is a noticeable improvement in the performance, replace the antenna.

Body Noise. If the car you're working on is old and loose in the joints, you may have to do some *bonding* in order to get the noise down to an acceptable level. Bonding consists of fastening strips of heavy woven metal braid between different parts of the car—mainly between the hood and front fenders. This is necessary in order to keep all of the metal parts of the car at the same electrical potential, and prevent the development of static charges between them. Try grounding the hood to the cowl or front fenders by sticking a heavy screwdriver between them and twisting to make a ground through the paint. If you can hear a reduction of the noise, no matter how small, install a bonding strap between the two parts.

37-4. WHERE TO SERVICE THE AUTOMOBILE RADIO

One big decision which you must make on every car-radio job is whether it is necessary to take the set out of the car in order to service it. The time saved by a

correct decision may amount to several hours. Only certain jobs can be profitably done in the car. These are such jobs as changing vibrators, fuses, tubes and speakers that can be removed *without* pulling the set first.

Note: As a general rule, first check every part that can be repaired in the car.

For the conventional sets (those not using transistors or tubes), you should develop a series of quick checks that you automatically apply to each set. Although you can use your own methods after you've gained some experience in checking auto radios, we recommend that you follow this basic outline:

Step 1. When you get into the car, turn on radio and switch. Listen for the buzz of the vibrator, and look to see if the dial light comes on.

Step 2. If you hear no buzz, and see no light, check the fuse. This will be found in the fuse-holder in the hot wire. The hot wire runs from the case of the set up toward the ignition switch (usually on your left as you sit behind the wheel). If the fuse is blown, don't replace it yet. Pull the contacts out of the fuse holder and touch them together. Listen for the buzz of the vibrator.

Step 3. If the vibrator begins to buzz, listen for the set to play after sufficient time has been allowed for the tubes to heat up. If it does play, and sounds normal with no excessive vibrator hash or noise, replace the fuse. The chances are that it has blown because of either a surge of current from the generator or a momentary sticking of the vibrator points. This can happen once in a while without there being any serious trouble in the set.

Step 4. If you get a big spark when you put the ends of the wires together, or if the vibrator starts but has an unusual buzz, as if it were loaded down, open the fuse lead. Take the bottom lid off the set, and locate the rectifier tube. In most sets, it will be a type 6X5 (metal or glass), 6X4 (miniature glass), 0Z4 (metal), or, in an old set, possibly a type 6Z4/84. In any case, it will be located very close to the vibrator. Remove

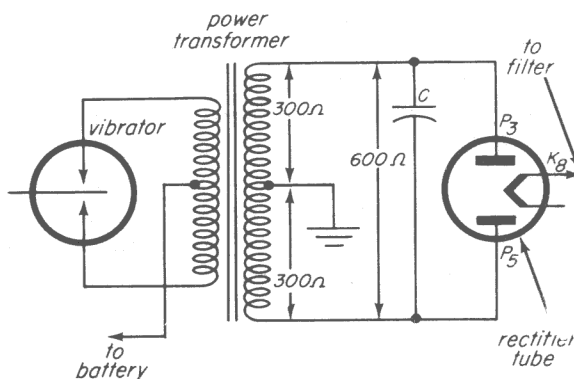


Fig. 37-23

this tube, and make an ohmmeter check (Fig. 37-23) between the plate pins, then from each plate pin to chassis. The illustration gives typical power-transformer/rectifier-tube circuit, as used in almost all auto-radios. Note the pin numbers given on plates of rectifier tube; these are correct for 6X5 and OZ4, but not for others. Note the resistance readings given; these are what you should get when taking readings from the top of the socket. As you can see, if the buffer condenser C were shorted, you would read 300 ohms from each plate to ground, but much less when measuring from plate to plate.

This is a simple series circuit; resistances in series merely add. If you don't get double the reading, the buffer is leaking and placing resistance in parallel. A normal reading will be about 300 ohms from each plate to chassis, and 600 ohms plate-to-plate. If you get the 300 ohms plate-to-ground, but less than the sum of the two readings plate-to-plate, the buffer capacitor is shorted or leaky, and the set must be removed from the car.

Step 5. If you see a big spark when fuse leads are touched together but there is no light and no buzz, remove the vibrator and try again. If you get a very small spark, and the tubes and pilot lamp light up, the vibrator is stuck. Replace it with a new one and repeat the test. Unless the buffer condenser is shorted or leaky, this should make the set play.

Step 6. If you hear a buzz but no other sound and the fuse is good, take the lid off the set to expose the tubes. Look for an unlighted tube. If the set has metal tubes,

wait until they warm up, and then feel the tubes; if any are cold, they are likely to be dead. Replace and check.

Step 7. If the tubes are all lit up in Step 6, leave the set still on and pull the audio-output tube (a6V6-GT, 6AQ5, etc.) from the socket. Listen for a loud pop in the speaker. If there is no pop, turn the set off and check the speaker for continuity if it is an external speaker. Pull out the speaker plug and measure between the two pins that are connected to the two wires. The normal resistance of speaker voice coil is about from 3 to 4 ohms. Listen also for a small click in speaker when ohmmeter prods are touched to the wires. An open circuit reading means either an open voice coil or broken connecting wires. If you read the correct resistance but there is no sound in the speaker, the speaker may be so full of dust and dirt that voice coil is stuck. This is quite common with auto-radio speakers, especially those that are mounted horizontally and catch considerable dirt. The only cure for this is a new speaker.

Step 8. If the set plays but is very weak, and a strong local station produces fair volume but no out-of-town stations come in at all, the antenna may be defective or, more likely, the r-f amplifier tube may be dead. Remove the lid of the set and check. If the r-f tube is dead, enough of the signal from a strong local station will leak through to let the set play very weakly. If the tube is all right, check the r-f coils, r-f tuning, etc.

Also check the action of the antenna trimmer capacitor. This small, capacitor mounted on the side of the case close to the antenna socket tunes the antenna to the set. This trimmer should have a very perceptible peak when tuned back and forth on a station around 1,400 kc. If it does *not* have a peak, but the volume of the set remains constant whatever the setting of this condenser, check the antenna. This symptom usually indicates a severe leakage across the antenna. Pull out the plug and temporarily substitute a new antenna, holding it in the hand, while adjusting the trimmer. If this brings back the volume and the trimmer again has a definite peak, the old antenna is definitely bad and must be replaced.

If the antenna trimmer shows a peak, but the r-f trimmer does not, the trouble is inside the set. The set will have to be removed from the auto. The trouble might be a bad r-f interstage transformer or a short in the tuner, but in either case the job will require bench work.

Rear seat speakers can be a source of

trouble, too. They are usually connected through a switch, which allows the driver to select either the front speaker, the rear speaker or both. If the switch was on rear, and that speaker happened to be open, you might be misled into thinking the set was defective. Always satisfy yourself thoroughly that the trouble is definitely in the set before you remove the set.
